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Wildland-Urban Interface Fires in New Zealand: Current Situation and Forthcoming Research Projects

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Introduction

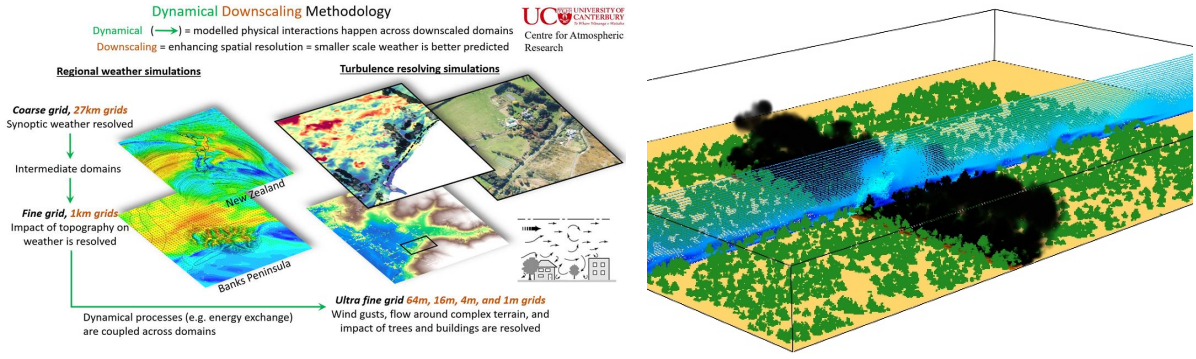
During the last decade, more countries have become considerably affected by wildfire. In Europe for example, northern countries such as Sweden, Norway and Scotland realized that they are not immune to this phenomenon. In Australasia, recent exposure of New Zealand's urban communities to destructive wildfires has prompted local researchers to design new multidisciplinary research projects, ultimately aiming to prepare New Zealand society to face more sever Wildland-Urban Interface (WUI) fires. This article briefly discusses the state of the problem and describe some of the current and upcoming local research projects around this topic.

The year 2020 was particularly devastating in terms human lives and property lost around the world. In Australia alone, 3000 houses were destroyed and 33 people killed during the catastrophic 2019/2020 fire season [1]. While in neighbouring New Zealand the level of destruction was not at the same scale, recent fire events set off the alarms and raised questions about how devastating future fire seasons will be, and how well prepared the country is to face it [2, 3]. 2016/2017 New Zealand WUI wildfire events, including Port Hills fire, resulted in the most destructive fire season in a century [4]. Very recently, Lake Ohau fire [5] showed a comparable destructive power. Those events alone might not be sufficient to define a significant trend, but considering the vulnerability of New Zealand to climate change [6, 7] and expansion of wildland-urban mixed environment [8], they constitute a clear sign of a new growing risk that needs to be addressed. Increasing of climate severity (e.g. hotter and dryer seasons) in New Zealand will potentially result in more intense and frequent fires, due to factors such as dryer fuel vegetation and greater wind speeds. Likewise, expansion of urban presence in wildland environments will considerably increase the potential damage of fires and is expected to raise the likelihood of vegetation ignition.

Several organizations in New Zealand, including the University of Canterbury, Scion and Fire Research Group Limited are currently cooperating to gain a holistic understanding of the WUI problem, which is essential to support policymaking and firefighter protocols that protect New Zealand communities. WUI computational modelling of fire behaviour at the fuel-atmospheric dynamic interface is one of the research challenges that will be addressed through a collaborative research project starting in 2021. The research has two interconnected objectives aimed to better understand fire behaviour at the WUI,

1. Numerical simulation of wind turbulence associated with real atmospheric boundary layer development (fig. 1a), and
2. Simulation of fire behaviour for real New Zealand fuel and urban canopy types (fig. 1b).

The research team aims to dynamically couple the turbulence resolving Parallelized Large Eddy Simulation Model (PALM, https://palm.muk.uni-hannover.de/trac) with the WUI module included in the Fire Dynamics Simulator (FDS) developed by NIST and US Forest Services [9]. The coupling will allow multiscale atmospheric boundary layer turbulence interacting with the physical and chemical dynamics of the WUI fuels. This will be demonstrated in New Zealand high-risk WUI wildfire scenarios, supported by state-of-the-art measurements of fire spread rate, vegetation distribution, topography characteristics and atmospheric conditions from an ongoing experimental campaign [10]. Results will be valuable to assess the ability of simulation tools to model realistic New Zealand WUI fire scenarios, as well as to support the development of a primary risk assessment framework, with potential to be used as guideline by countries experiencing a similar situation.



a) b)

Figure 1. Modelling of fire-atmospheric interactions: a) Numerical simulation of wind turbulence associated using PALM and b) Simulation of wildfire behaviour using FDS.

Flammability properties of several types of New Zealand WUI bush vegetation will be experimentally and numerically characterised from small scale through Differential scanning calorimetry (DSC) and thermogravimetric analysis (TGA), to medium and vegetation scale using cone calorimeter and bush-to-bush propagation schemes. Outputs of this project will result in a detailed database of vegetation flammability characteristics, able to support implementation of WUI fires protection strategies, advanced fire severity mapping and regulatory measures in New Zealand.

From a global point of view, results from these projects are expected to help clarifying the nature of the risk, providing momentum to local and international WUI fires research efforts, and to support future initiatives aiming to increase the level of safety of New Zealand society.

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